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Norwell Groundwater Protection Study

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NORWELL

GROUNDWATER PROTECTION

STUDY

OCTOBER 1987

METROPOLITAN AREA PLANNING COUNCIL
BOSTON, MASSACHUSETTS

ABOUT THIS REPORT

This report was prepared by the staff of the Metropolitan Area Planning Council under the supervision of the Executive Director. The Metroplitan Area Planning Council is the officially designated regional planning agency for 101 cities and towns in the Boston metropolitan area. The Council offers technical assistance to its member communities in the areas of land use, housing, environmental quality, energy, transportation, and economic development.

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The Norwell Groundwater Protection Committee met throughout the course of this study and provided invaluable guidance and assistance in the production of this report. Through the committee's leadership and commitment, the town of Norwell has an opportunity to better manage and protect its valuable water resources. The members of the Committee are:

Ronald Smith	Chairman
Robert Penniman	Vice Chairman
Steve Ivas	Clerk-Secretary
George Cavanagh	Fire Chief
Leonard Jackson	
Phillip Joseph	Alternate/Dealers
Donald LeClair	Dealers' Designee
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NORWELL GROUNDWATER PROTECTION STUDY

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Chapter 1

BACKGROUND AND SUMMARY

This technical assistance report was prepared at the request of the town of Norwell, whose officials have expressed an interest in protecting the town's water supply sources. Norwell meets all of its water supply needs with local sources of groundwater. The need to protect the aquifers which supply the town's drinking water has been underscored by the recent contamination of several municipal wells in neighboring towns. It is also important in light of the fact that recent growth in water demand has exceeded the system safe yield on peak demand days.

Norwell is a developing suburban community of about 9,200. Although the town grew rapidly from 1950 to 1980, in the last decade growth has slowed considerably, and the population is projected to stabilize at about 11,000 by the turn of the century.

Norwell operates 9 wells which are located in sand and gravel aquifers generally in the northern and western portions of the town. The aquifers underlie about 2054 acres, or 15 percent of the town. About 27 percent of the aquifer area is developed, largely with residential land uses. This aquifer area is the major focus of this study, since any polluting activities in this area could affect the town's water supply sources.

The overall methodology of this study included the following steps:

- inventory the water resources of the town and identify areas of particular significance to the quality and quantity of the water supply;
- inventory existing land uses and identify potential sources of contamination in the study area, and assess their potential threat to the quality of the water supply sources;
- evaluate the zoning of the undeveloped land within the study area and determine the extent to which new permitted land uses could affect the water supply in the future;
- review all existing federal, state, and local laws and regulation which control land uses and known sources of contamination; and
- recommend additional local water supply protection measures to mitigate existing and potential land use and zoning conflicts identified.

All of the findings and recommendations of this study were reviewed by a Groundwater Study committee appointed by the Selectmen and comprised of representatives of the Planning Board, Board of Health, Water Commission, Conservation Commission, Fire Department and interested citizens. The Committee met throughout the course of the study and provided invaluable information and guidance.

Protection of the water supply sources is vitally important in Norwell because all drinking water comes from local sources and there are few if any practical alternative supply sources available to the town. Other towns in the region face supply shortages, and the Massachusetts Water Resources Authority cannot be considered an alternative. Norwell's ability to remain self-sufficient in water supply, and to grow economically, will depend on how well the town's groundwater resources are managed and protected over the long term. Norwell has a number of policies which currently contribute to the protection of the town's water supplies. For example:

- the town has a bylaw which regulates underground storage of petroleum and hazardous chemicals.
- the town owns several key parcels of conservation land in the vicinity of some of the wells;
- the zoning bylaw includes a floodplain, watershed, wetlands protection district;
- the town has designated several areas where road salt is not applied to reduce the levels of sodium in the groundwater;
- the Board of Health has adopted regulations which include septic systems requirements more stringent than Title 5.

This study has examined land uses, zoning, and regulations in the town and has identified areas requiring additional protection to insure the long term protection of the groundwater resources. This has led to a set of recommendations for augmenting the town's policies and regulations for protecting the water supply. The major elements of this program are:

- a recommendation to conduct additional hydrogeologic studies to identify areas of contribution to wells;
- a zoning amendment to create an Aquifer Protection District;
- an amendment to the underground storage bylaw to include above ground storage, in order to regulate hazardous materials handled by businesses and industries;
- an amendment to the earth removal regulations to require that the depth of excavation extend no deeper than ten feet above the water table, as determined by field evaluation;
- amendments to the subdivision regulations to allow the Planning Board to require data and mitigation measures for groundwater protection;
- collection of household hazardous wastes and public education about proper handling and disposal of hazardous materials.

Implementation and administration of the recommended program will require the cooperation and support of several town boards, as well as Town Meeting support for new or amended bylaws. An important element for successful implementation will be public education. The Groundwater Study Committee has a useful role to play in promoting these efforts,which may include public meetings and presentations. Increasing public awareness of the need for groundwater protection may be as important as modifying local regulations in meeting the goals of the groundwater protection program.

In the chapters that follow, the background, analysis,and the recommended groundwater protection program are described in detail. It is hoped that this study will focus attention on groundwater protection and assist the town of Norwell in the development of a comprehensive water supply protection program.

CHAPTER 2

WATER SUPPLY SYSTEM PROFILE

Prior to examining the protection needs of Norwell's groundwater resources, it is useful to have an overview of the elements and operation of the water supply system. This will aid in formulating a protection plan which is responsive to the needs of the town.

WATER USE AND CONSUMPTION

The Norwell Water Department supplies water to approximately 8,100 people or 88% of the town's population. There are approximately 2500 connections within the system. In 1985 the system delivered a total of 465 million gallons with an average day demand of 1.27 million gallons and a maximum day demand of 1.90 million gallons mgd.

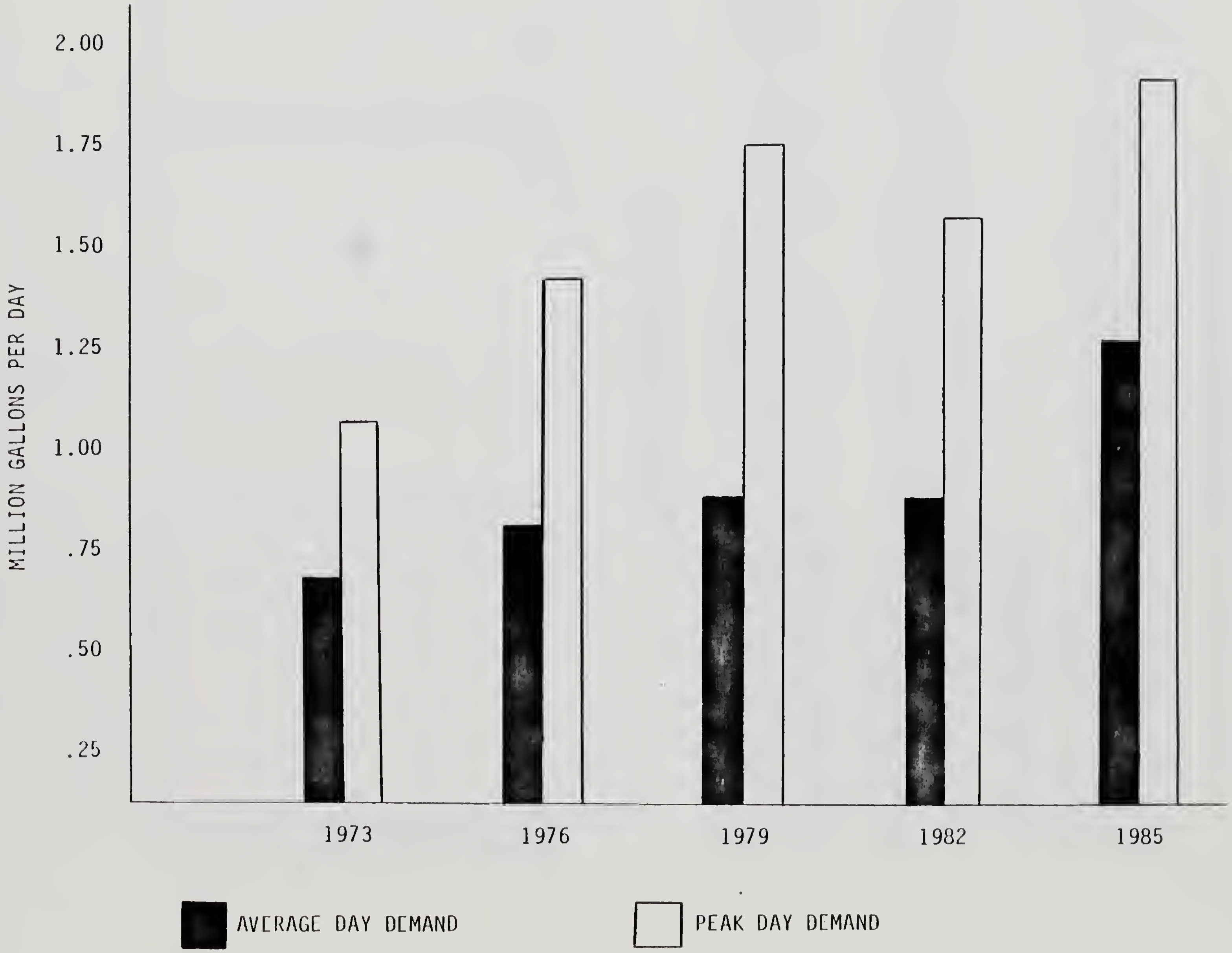
Historic water use trends are shown in Table 2-1. Since 1972, average day demand has more than doubled, from 0.61 million gallons per day (mgd) to 1.27 mgd, while peak day demand also doubled, from 1.0 to 2.0 mgd. For the last two years, peak demand has exceeded the estimated safe yield of the system, which is approximately 1.7 mgd.

TABLE 2-1 HISTORIC WATER USE:
AVERAGE AND PEAK DAY USE

YEAR	AVERAGE DAY (mgd)	PEAK DAY (mgd)
1986	1.42	2.00
1985	1.27	1.90
1984	1.03	1.64
1983	.89	1.67
1982	.88	1.55
1981	.89	1.49
1980	.89	1.78
1979	.83	1.75
1978	.84	1.43
1977	.79	1.58
1976	.78	1.40
1975	.70	1.66
1974	.65	1.22
1973	.61	1.05

Figure 2-1

HISTORIC WATER DEMAND, 1973-1985



One possible factor in the recent increase in demand is system leakage. The town has no regular leak detection program, but in 1987, 17 leaks were found, including at least one large leak in an eight inch main.

Projections of future water demand made in previous reports to the town (Whitman and Howard, 1980) estimated that by the year 2005, the maximum day demand would rise to 3.1 mgd. This projection is based on the assumption that the town's population would be 13,000 in 2005, and that nearly 100% of the town would be served by town water. However, it is now apparent that population is growing at a considerably slower rate than expected in earlier reports. The 1984 population was estimated to be 9208, and the MAPC projection for the year 2010 is 11,100.

Water Supply Sources

Local groundwater is the sole source of public water supply in Norwell. The town operates 9 gravel pack wells with a combined yield of 2.3 million gallons per day. (See table 2-2). However, the safe yield of the system is about 1.7 mgd, due to the fact that several wells in close proximity to each other draw from the same aquifer, and their yields cannot be added.

Table 2-2 Public Supply Wells

Well No.	Location	year installed	Diameter	Depth	yield (gal)*
1	South St.	1956	8"	63'	336,000
2	Grove St.	1956	8"	45'	230,400
3	Grove St.	1964	8"	25'	172,800
4	Ridge Hill Rd.	1966	12"	39'	302,400
5	Grove St.	1968	12"	31' 6"	288,000
6	South St.	1969	12"	42'	336,000
7	Washington St.	1972	8"	40'	192,000
8	Washington St.	1974	12"	45'	139,200
9	Bowker St.	1967	8"	36"	288,000

*Based on pumping at design rate of 16 hours/day.

Historic pumping trends of each of the town's wells is shown in Table 2-3. While production of each well varies from year to year, reliance on Wells No. 1, 7, 8, and 9 has significantly increased over the last ten years, while the contribution of the remaining wells has remained relatively constant.

Potential Future Sources

The town is currently developing an additional gravel packed well in the Grove Street area, near the Hingham border. The proposed well is now undergoing DEQE permitting. Part of the DEQE Zone I (400 foot radius) is within the town of Hingham, on town-owned conservation land. The Norwell Water Commissioners have consulted with the Hingham Conservation Commission about the protection requirements of the land within Zone I in Hingham.

Water Quality

Norwell's water meets all quality standards of the Safe Drinking Water Act, with the exception of sodium levels in four of the wells (See Tables 2-4, 2-5, 2-6). Wells No. 4, 7, and 8 have sodium levels more than twice the standard of 20 mgl, and well No. 1 exceeds the standard by a factor of three. However, when water from these wells is mixed with the rest of the system, the resulting sodium levels are within the standard. Table 2-5 shows that sodium levels have flucutated in recent years, but the levels have increased in several wells in 1986. Recent trends in nitrate levels are shown in Table 2-6, which shows that nitrate has increased in three wells and held fairly stable at most others.

Table 2-3

HISTORIC WATER USE BY SOURCE (million gallons)

Well No.	1	2	3	4	5	6	7	8	9	TOTAL
1985	84	50	20	61	76	96	34	19	24	465
1984	69	44	16	57	70	46	34	21	20	377
1983	48	36	15	50	54	45	32	22	23	325
1982	58	34	18	61	47	52	23	26	3	322
1981	55	30	17	63	52	63	23	23	-	324
1980	54	36	23	70	60	44	21	15	-	324
1979	56	39	26	65	59	31	13	14	-	303
1978	52	49	18	60	59	43	14	11	-	305
1977	36	50	19	53	50	40	25	15	-	208
1976	42	54	27	45	64	46	5	3	-	286
1975	41	40	27	47	62	39	-	-	-	256
1974	22	46	17	56	48	48	-	-	-	237
1973	23	46	3	62	73	15	-	-	-	222

Table 2-4

Norwell Drinking Water Quality in 1985 (mg/l)/1

	MCL/2	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8
Color	15	5	5	7	10	7	25	5	7
Odor	3	0	0	0	0	0	0	0	0
pH	6.5 - 8.5	6.2	6.5	6.1	5.9	5.9	6.0	5.6	5.8
Alkalinity Total (CaCo3)	NS	19	18	10	12	8	13	10	13
Hardness (CaCo3)	NS	29	32	29	56	29	32	46	60
Calcium (Ca)	NS	7.2	7.3	6.8	13	6.8	7	11	14
Magnesium (Mg)	NS	2.8	3.5	2.9	5.5	2.9	3.5	4.5	6.0
Sodium (Na)	20	64	9.2	18	35	17	23	36	51
Potassium (K)	1.3	1.3	0.4	0.6	1.3	0.8	0.8	1.2	1.1
Iron (Fe)	0.3	.00	.00	.00	.00	.00	.14	.02	.03
Manganese (Mn)	0.05	.12	.05	.02	.12	.01	.87	.04	.03
Sulfate (S04)	250	17	12	15	23	14	17	19	17
Chloride (Cl)	250	85	12	31	68	33	44	68	95
Nitrogen (nitrate)	10.0	0.5	0.4	1.0	3.7	1.1	0.1	3.5	1.6
Copper (Cu)	1.0	.00	.01	.02	.04	.02	.06	.02	.00

1 Quality test results for well #9 not available

2 Maximum contaminant level as established by the Safe Drinking Water Act
NS denotes no standard applies.

Table 2-5

WATER SAMPLE ANALYSIS - SODIUM (MGL) *

Well	#1	#2	#3	#4	#5	#6	#7	#8
1986	67	11	19	43	22	25	44	-
1985	64	9.2	18	35	17	23	36	51
1984	65	11	12	38	16	.6	23	34
1983	-	10	15	34	17	15	21	7.2
1982	62	11	13	38	24	25	49	38
1981	61	9.6	9.7	43	9.5	24	42	-

*Drinking water standard is 20 mgl.

Table 2-6

WATER SAMPLE ANALYSIS - NITRATE (MG/L)*

Well	#1	#2	#3	#4	#5	#6	#7	#8
1986	.6	.3	1.1	4.5	2.0	.1	2.7	2.7
1985	.5	.4	1.0	3.7	1.1	.1	3.5	1.6
1984	.6	.2	.6	-	4.4	.1	1.4	1.7
1983	-	.3	.8	-	1.4	.1	1.1	0
1982	.9	.4	.6	4.3	1.8	.2	1.1	1.8
1981	.9	.4	.1	6.6	.4	.2	3.1	-

*Drinking water standard is 10 mgl.

Chapter 3

WATER RESOURCES AND ENVIRONMENTALLY SENSITIVE AREAS

This chapter describes the characteristics of the natural environment within the town of Norwell and their significance to the public water supplies. The areas addressed are: watershed areas, geology, groundwater resources, soils,and wetlands.

Watershed Areas

The town of Norwell lies within the drainage basins of the North and Weir Rivers, both of which flow east into the Atlantic Ocean. The town's municipal wells are located within four subbasins which covers about 40 percent of the town, primarily in western sections. The subbasins and their sizes are as follows:

Wildcat Brook	1450 acres
Third Herring	900 acres
Lower Third Herring	659 acres
Weir River	486 acres

Geology

Norwell's geology consists of bedrock which is covered by varying depths of unconsolidated materials which were deposited by ice age glaciers. The surficial materials can be classified into two major groupings: till and stratified drift deposits. Till is an unsorted, mixture of various grain sizes, from clay to sand to boulders. Most till in Norwell was deposited as a ground moraine, or forms small oval shaped hills called drumlins. These materials are not very permeable, and therefore are not favorable aquifers. Stratified drift deposits include sand and gravel deposits which are well sorted into layers of somewhat uniform grain size, making them both porous and permeable. These qualities make them favorable for storage and transmission of significant quantities of water. Most of these formations were deposited by glacial meltwaters in the form of outwash plains, kames, kame deltas, and ice-channel deposits. Stratified drift deposits are frequently found as "buried valleys," where meltwater deposits fill in depressions in the underlying bedrock which represent the pre-glacial drainage pattern.

GROUNDWATER RESOURCES

The occurrence of groundwater in the town is controlled by the surficial and bedrock geology. Aquifers which yield sufficient quantities of water for public supply wells are generally found in thick deposits of sand and gravel, which are capable of storing and transmitting significant amounts of water. The thickest areas of such permeable deposits are generally found in buried valleys.

In Norwell, the sand and gravel deposits are relatively thin, which limits their potential groundwater yield. Thus, each well has a relatively small yield, and many wells are needed to supply the town's requirements.

According to the U.S. Geological Survey Hydrologic Atlas, there is a band of moderately to highly favorable aquifers in the north western and central western portion of the town (see Map). This 2087 acre aquifer area is the most significant and sensitive part of town with regards to the quality of Norwell's drinking water. This area may potentially affect the town's water supplies. This area should receive special attention in any groundwater protection measures.

Soils

There are two major solid associations within Norwell. The Scituate-Essex-Merrimac association occupies the upland portion of town. These soils are deep, coarse, sandy loams underlain at a depth of 10 to 30 inches by firm, coarse glacial till. Most of the town's wells lie within this soil association. The coastal area and North and South River corridors fall mostly in the Tidal Marsh-Dune Land-Coastal Beach Association. Some areas consist mainly of organic matter, others of mineral material, chiefly silt and clay.

WETLANDS

Wetlands are low-lying, transitional areas between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetland areas have several unique functions and values with respect to water supplies: they filter pollutants entering streams, provide temporary storage for flood control, supply base flows for streams and rivers, and supply water to the surface system in periods of limited rainfall. In Massachusetts wetlands are delineated by the presence of wetlands vegetation under the state Wetlands Protection Act.

According to the MacConnell land use maps about 243 acres or 2 percent of the town is in freshwater wetlands. Freshwater wetlands cover about 70 acres of the aquifer study area. There are also about 428 acres of salt water wetlands in Norwell, about 9 acres of which lie over the aquifer area.

Chapter 4

LAND USE AND WATER SUPPLY IMPACTS

This Chapter describes the uses of land in the town of Norwell, and examines the potential impacts of land use on the quality and quantity of water supply sources in the town. After a brief review of the recent growth and development trends of the town, water supply impacts will be addressed in terms of the potential sources of contamination associated with land use.

HISTORIC DEVELOPMENT TRENDS

This section reviews the last three decades of growth and development in Norwell. This perspective aids in understanding the existing land uses, as it provides information on past activities which today may affect the water supply sources.

Table 4-1

POPULATION DATA, 1950 - 1980

Year	Population	Population Density (pop. per square mile)	% Change
1950	2,515	123	-
1960	5,207	254	107
1970	7,796	380	50
1980	9,182	447	18

The data show that Norwell's population has quadrupled in 30 years. However, the growth has gradually proceded at a slower rate as illustrated by a decrease in percent changes over the 30 year period.

The historic population growth in Norwell is reflected in the changing land uses in the town over the last 30 years. Table 4-2 shows a breakdown of land uses for 1951 and 1984. Developed land in 1984 is five times what it was in 1951. The greatest change is found in residential land uses, which increased 2,280 acres. The greatest increase percentage wise was in commercial lands, which grew from two acres to 175 acres, an 8,650 percent increase. The largest loss was of forested land, which declined 1628 acres. Nearly 1000 acres agricultural lands were lost.

Table 4-2

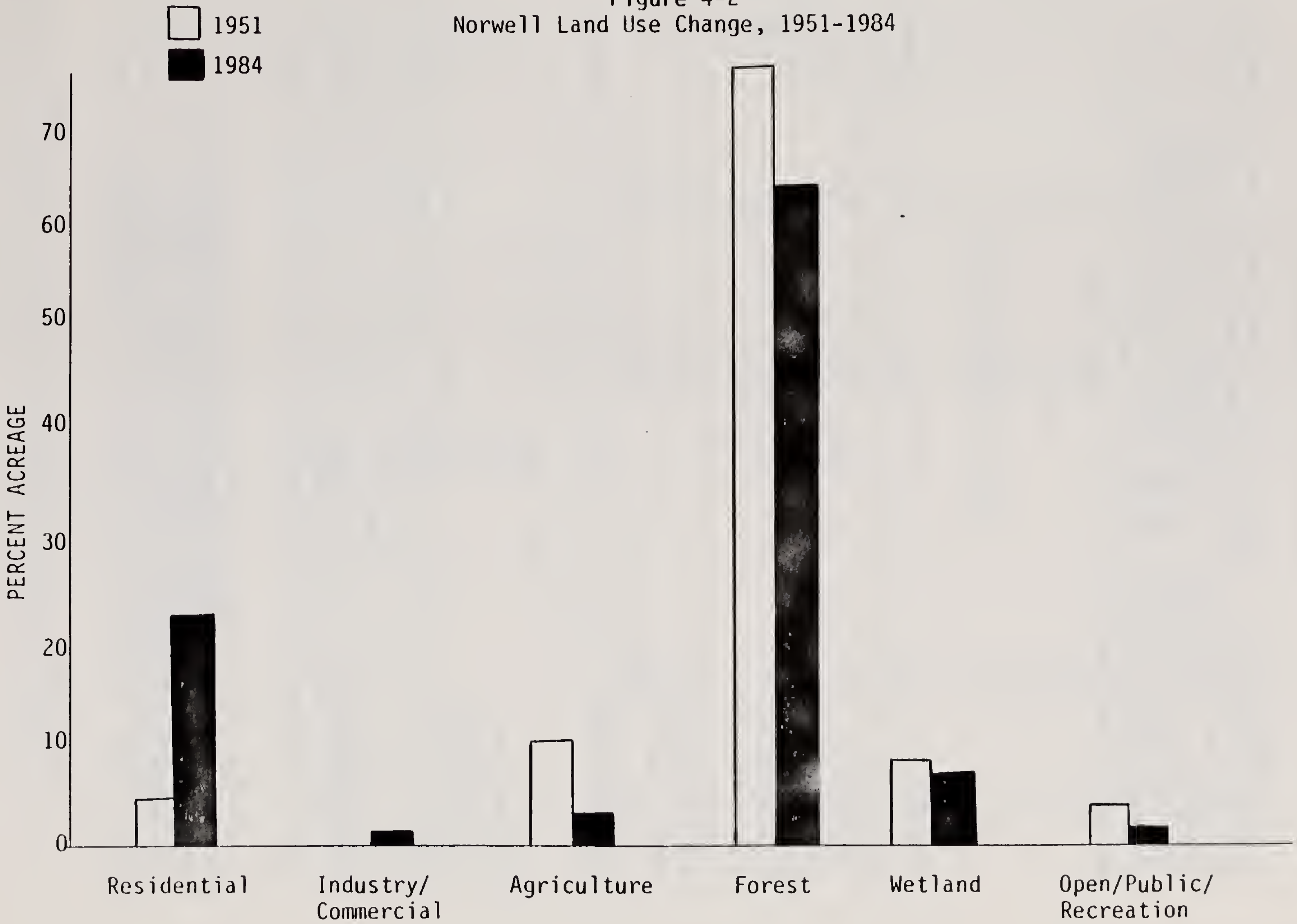
NORWELL LAND USE CHANGE, 1951-1984/1

Land Use	1951 acres	1984 acres	change acres	percent change
Residential	567	2,847	2,280	402
Industrial	-	41	-	-
Commercial	2	175	173	8,650
Open & Public	-	108	-	-
Transportation	-	180	-	-
Mining/2	56	-	-	
Recreation/2		39	-	-
Total Developed Land	569	3,436	2,879	505.9
Forest	9,716	8,088	-1,628	-17.0
Salt Wetland	556	428	128	-23.0
Fresh Wetland	206	243	37	18.0
Open	534	316	-218	-40.8
Agriculture	1,362	393	-969	-71.1
Water	190	219	29	15.3
Total Undeveloped Land	12,564	9,687	-2,621	-118.6

1) Source: MacConnell, University of Massachusetts
2) Mining and Recreation were not included in the 1951 survey

NOTE: MacConnell land use maps are based on interpretation of aerial photographs, and are not field checked. The minimum parcel size mapped is 3 acres. The acreage counts based on MacConnell mapping are therefore approximate, but they are the best available land use data.

Figure 4-2
Norwell Land Use Change, 1951-1984



SUMMARY OF EXISTING LAND USE

The current land uses in the town have been classified for analysis and mapped in Figure 4-1. Table 4-3 shows the acreage of each land use category in 1980. Norwell is about 26 percent developed of which approximately 23 percent is residential land. Industrial and commercial uses represent less than two percent. About 74 percent of the town is considered undeveloped of which 62 percent is forested. Agriculture and Wetland's represent only 8% of total land uses.

Table 4-3

Norwell Land Use, 1984

Land Use	Acres	Percent
Residential	2847	21.7
Industrial	41	.3
Commercial	175	1.3
Open & Public	108	.8
Transportation	180	1.4
Mining	56	.4
Waste Disposal	-	-
Outdoor recreation	39	.3
Developed Land	3446	26.2
Forest	8088	61.6
Salt Wetlands	428	3.2
Fresh Wetlands	243	1.9
Agriculture	393	3.0
Water	219	1.7
Open	316	2.4
Undeveloped Land	9687	73.8
Total	13133	100

The aquifer which supplies Norwell's wells covers approximately 2,000 acres or about 15 percent of the towns total acreage (Table 4-4). Twenty-seven percent of the aquifer is developed; most of this land is used residentially, 18 percent. Undeveloped lands occupy 73 percent of the aquifer area. Forested lands comprise the largest share, 64 percent.

Table 4-4

Norwell Water Supply Aquifer
Land Use, 1984

Land Use	High Favorability Aquifer, Acres	Medium Favorability Aquifer, Acres	Total Aquifer Area, Acres	Percent of Total Aquifer Area
Residential	112	265	377	18.0
Industrial	4	24	28	1.4
Commercial	14	21	35	1.7
Transportation	11	28	39	1.9
Mining	2	35	37	1.8
Open & Public	14	31	45	2.2
Developed Land	157	404	561	27.0
Forest	308	1025	1333	64.0
Salt Wetlands	-	9	9	0.4
Fresh Wetlands	31	39	70	3.3
Agriculture	27	38	65	3.1
Open	6	43	49	2.2
Undeveloed Land	372	1154	1526	73.0
Total	529	1558	2087	100

LAND USE/WATER SUPPLY IMPACTS

Land uses within the water supply watershed can affect both water quality and water quantity through physical alteration of the environment which changes drainage patterns and rates of runoff and recharge, and through discharge of contaminants to surface or groundwater. In this Chapter, the potential impacts of land uses on water supplies are analyzed in terms of the physical alterations and chemical contaminants associated with each. For each of these potential sources of contamination, the analysis presents:

- o The characteristics and water supply impacts
- o The land was associated with each; and
- o existing conditions in Hingham describing the prevalence of these land uses within the water supply watershed

The potential sources of contamination addressed are: underground fuel storage tanks, wastewater, road salt, leachate, hazardous wastes, pesticides and mineral extraction.

As demonstrated by Table 4-4 approximately 73 percent of the aquifer area is undeveloped. Such primarily undeveloped property provides a natural recharge area for groundwater and surface water, and this has no adverse effect on either the quantity or quality of drinking water supplies. However, much of this land has the potential of future development. The developed land uses in the watershed have the potential to cause impacts on the quantity and quality on water supply in Norwell. The relationship between land uses and potential drinking water impacts is summarized in Figure 4-4 and described in the following section.

Figure 4-4

EFFECTS OF LAND USES ON WATER SUPPLY SOURCES

	POTENTIAL DRINKING WATER CONTAMINATION					
LAND USE	Underground Fuel Storage Tanks	Wastewater	Road Salts	Leachate	Hazardous Wastes/Materials	Pesticides Herbicides
Residential	○	●	○		○	○
Institutional	○	●	○		○	○
Commercial	●	●	○	○	●	
Industrial	●	●	○	○	●	
Agricultural	○	●			○	●
Transportation/Utilities	○		●		○	●
Waste Disposal/Mining	●			●	●	

● Probable Relationship

○ Possible Relationship

POTENTIAL SOURCES OF CONTAMINATION

1. Underground Fuel Storage

a. Potential Impacts. Leakage of tanks or piping which are subject to corrosion or puncturing. Unprotected steel tanks have an average life expectancy of 15 years in corrosive soils. Most soil types in Massachusetts are corrosive. Once it leaks, gasoline can move through the ground and contaminante much water, since concentrations of more than several parts per billion are considered unsafe.

b. Land Use Associations. Fuel storage is typically associated with service stations, fuel companies, auto dealerships, public works facilities, bus and truck fleets, schools, churches and other institutions, and residences where large underground tanks are installed for additional storage.

c. Existing Conditions. There are 20 facilities (auto sales and service) storing gasoline in Norwell which includes 64 tanks, 43 of these tanks are known to be more than 15 years old. (Tables 4-6 and 4-8). Residences, institutions, and small businesses are storing fuel in 105 underground tanks throughout the town (Tables 4-5 and 4-7).

2. Wastewater

a. Potential Impact. Both surface water and groundwater supplies can be affected by problems associated with disposal of sanitary wastes. Failing septic systems can be caused by improper siting, installation or maintenance. Soil type, depth to bedrock and depth to the water table can be major factors in septic systems failures. Such failures can introduce excessive nutrients, chlorides, bacteria and household chemicals into soil which can then leach into water supplies. According to DEQE, septic systems on lots less than 40,000 square feet in area have a greater potential to contaminate groundwater.

b. Land Use Associations. Residential, commercial, and industrial land use generate wastewater. These land uses occupy about 23 percent of the town.

c. Existing Conditions. The entire aquifer and watershed area is unsewered. Therefore, the area relies solely on septic systems to treat sanitary wastes. Consequently, the town's major concern relative to septic systems is that they are properly installed, operated and maintained.

Table 4-5

SUMMARY OF UNDERGROUND HEATING OIL PERMITS

Age of Tank (years)	Amount of Fuel Storage Permited (Gallons) 0-300	301-500	501-999	1000+	TOTAL
0-5	7	7	-	4	18
6-10	10	6	-	12	28
11-15	18	6	1	6	31
16+	6	6	2	6	20
unknown	3	3	-	2	8
Total	44	28	3	30	105

Table 4-6

SUMMARY OF UNDERGROUND FUEL LICENSES -- GASOLINE

Age of Tank (years)	Amount of Fuel Storage Permitted (Gallons) 500-6000	6,001-12,000	12,001+	Unknown	Total
0-5	3			-	6
6-10	-	-	-	-	-
11-15	8	1	-	1	10
16-20	27	4	1	1	33
21+	5	-	-	-	5
Total	43	8	1	2	54

Table 4-5

NORWELL UNDERGROUND FUEL STORAGE LICENSES

License Holder	Address	Number of Tanks	Capacity of Tanks	Year Installed	Fuel
Sears Roebuck	55 Accord Park Drive	1	10,000	1974	Unleaded fuel
Prestige Imports	22 Pond St.	1	500	1968	oil
		1	1,000	1968	waste oil
Hilltop Service	223 Main St.	-	11,000	1970	gasoline
		1	3,000	1952	gasoline
		1	4,000	1970	gasoline
		2	2,000	1952	gasoline
Boston Whaler	412 Washington St.	1	5,000	1966	#4 fuel oil
Hancock Paint & Varnish	109 Accord Park Dr.	1	1,500	1969	Naptha
		2	1,500	1969	Linseed
		2	1,500	1969	Out of Use
		1	1,500	1969	460 Solvent
		1	5,000	1969	663 M.S.
		1	5,000	1969	Fuel Oil
AMN Limited (Norwell Car Wash)	424 Washington St.	4	4,000	1967	gasoline
Town Highway Dept.	310 Main St.	2	5,000	1972	gasoline
		1	5,000	1972	diesel
Norwell Police Dept.	River St.	1	2,000	1970	gasoline

License Holder	Address	Number of Tanks	Capacity of Tanks	Year Installed	Fuel
Mobil Oil	85 Washington St.	-	27,000	1970	gasoline
		1	500	1970	waste oil
		1	500	1970	fuel oil
Jiffy Lube	45 Washington St.	1	3,000	1985	lube oil
		1	3,000	1985	waste oil
		1	1,000	1985	trans. fluid
Hawkins Realty Trust	55 Washington St.	1	2,000	1974	gasoline
Christy's Sunoco	95 Washington St.	1	2,000	1971	oil
		-	18,000	1971	gasoline
Norwell Sunoco	117 Pond St.	3	8,000	1987	gasoline
		1	500	1987	waste oil
		1	500	1987	fuel oil
Shell Oil	72 Washington St.	3	8,000	1970	gasoline
		1	500	1970	fuel oil
		1	500	1970	waste oil
Getty	Pond & Whiting Sts., Hingham	2	4,000	-	gasoline
		1	4,000	1967	gasoline
Joseph's Pontiac & GMC Truck	724 Main St.	3	8,000	1987	gasoline
		1	500	1955	waste oil
Shell Oil Company	10 Washington St.	3	12,000	1984	gasoline
		1	500	1966	waste oil

Table 4-6

NORWELL HEATING OIL PERMITS-UNDERGROUND STORAGE

ADDRESS	CAPACITY OF TANK	YEAR INSTALLED
10 Arrowhead Dr.	1,000	1986
52 Barstow Ave.	300	1985
226 Bowker St.	2,000	1972
52 Bridge St.	275	unknown
17 Brookside Farm Way	300	1972
150 Central St.	500	1951
45 Central St.	300	unknown
246 Circuit St.	275	1974
156 Cross St.	500	1985
78 Cross St.	300	1969
292 Cross St.	500	1980
140 Cross St.	250	1976
167 Cross St.	275	1971
32 Crossbow Lane	300	unknown
16 E. Ridge Way	300	1972
20 Farm Hill Lane	500	1974
17 First Parish Rd.	250	1975
120 Forest St.	1,000	1959
Foxhill Lane	1,000	1976
14 Gerard Road	1,000	1982
9 Germaine Rd.	500	1971
16 Green St.	500	1976
92 Green St.	275	1980
60 Grove St.	1,000	1980
689 Grove St.	1,000	1984
85 Grove St.	475	1946
503 Grove St.	500	1986
i720 Grove St.	500	1976
62 Harbor Lane	300	1986
14 Harold's Way	1,000	1978
20 Harold's Way	500	1973
128 Jacobs Lane	500	unknown
48 Knollwood Rd.	1,000	1978
317 Lincoln St.	300	1972
172 Lincoln St.	1,000	1974
327 Main St.	300	1978
768 Main St.	1,000	1946
1150 Main St.	1,000	1976
761 Main St.	2,000	1976
613 Main St.	300 + 500	1986
802 Main St.	500	unknown
114 Main St.	1,000	1963
830 Main St.	275	1976
408 Main St.	500	1973

ADDRESS	CAPACITY OF TANK	YEAR INSTALLED
24 Masterhead	300	1971
74 Masthead Dr.	300	1973
22 May Elm Lane	274	1972
50 May Elm Lane	300	1972
18 Meadow Farms	300	1979
171 Mt. Blue St.	1,000	1978
565 Mt. Blue St.	500	1976
269 Mt. Blue St.	275	1971
73 Mt. Blue St.	300	1973
17 Oak St.	500	1960
27 Oakland Ave.	500	1985
8 Old Meetinghouse Ln.	300	1981
14 Old Meetinghouse Ln.	300	1983
121 Old Oaken Bucket Rd.	2,000	1969
279 Old Oaken Bucket Rd.	500	1985
16 Old Oaken Bucket Rd.	300	1973
14 Old Pottery Lane	1,000	unknown
61 Paradise Drive	500	1956
73 Parker St.	325	1974
126 Parker St.	300	1974
142 Parker St.	300	1971
266 Pine St.	300	1969
140 Pine St.	1,000	1953
187 Pine St.	275	1969
108 Pine St.	325	1971
283 Pine St.	275	1973
293 Pine St.	300	1980
72 Pleasant St.	300	1969
166 Pleasant St.	500	1958
242 Pleasant St.	2,000	unknown
311 Prospect St.	1,000	1976
273 Prospect St.	1,000	1971
13 Queen Anne Lane	300	1985
435 River St.	3,000	1980
506 River St.	1,000	1976
490 River St.	1,000	1971
479 River St.	500	1963
691 River St.	500	unknown
140 Riverside Dr.	500	1976
44 Simon Hill Rd.	300	1969
311 South St.	300	1972
40 South St.	1,000	1942
56 Stetson Rd.	2,000	1980
177 Stetson Rd.	300	1974
11 R.F. Higgins Dr.	275	1978
26 Stetson Shrine Ln.	1,000	1985
351 Summer St.	500	1986
170 Summer St.	995	1967
66 Tiffany Rd.	1,000	1971

ADDRESS	CAPACITY OF TANK	YEAR INSTALLED
199 Tiffany Rd.	300	1978
106 Till Rock Ln.	300	1978
340 Washington St.	500	1976
15 Wendall Avenue	550	1968
2 Wildcat Ln.	1,000	1974
248 Wildcat Ln.	275	1972
128 Winter St.	1,000	1977
280 Winter St.	260	1981
250 Winter St.	550	1975
95 Winter St.	500	1983
315 Winter St.	300	1972

3. Road Salt

a. Potential Impacts. Deicing chemicals such as sodium chloride applied to roads in winter or stored in uncovered piles can wash off pavements into surface water bodies or percolate through soils to groundwaters. Since standard water treatment systems are unable to remove sodium from drinking water, sodium concentrations which may be harmful to the health of some individuals may result. Also, at high concentrations, sodium can corrode water distribution pipes and water fixtures. Therefore, the Massachusetts Department of Environmental Quality Engineering has set a health standard of 20 mg/l for sodium. DEQE requires regular sampling and analysis of sodium concentrations in public water supplies and notification of customers if the concentrations exceed the standard.

b. Land Use Associations. Land uses which are associated with use of road salts are transportation, for maintaining road safety in the winter, and residential, institutional, commercial and industrial, for clearing parking lots and private drives.

c. Existing Conditions. Road salt used by the town of Norwell is stored under cover at the Highway Garage. The salt shed is outside the aquifer area, however it borders on a wetland area. The sand to salt mixture used by the town is 1:8. But, during a storm that ratio may be changed up to 1:3. Grove and Pond Streets (228) are heavily travelled and receive more salt than the other town maintained roads. A road surrounding Norwell High School, South Street, Accord Park, and Assinippi Park are all low salt areas. Norwell has a town by-law that places a limit on total salt usage for a year to be 1200 tons.

The State DPW maintains Routes 3 and 53, approximately 16 miles of highway. The State applies 100 percent salt to all roads, at a rate of 300 pounds per lane mile. Norwell has 55 lane miles. During a storm Rte 3 will receive 14,400 pounds of salt and Rte 53 will receive 2,700 pounds of salt.

4. Leachate

a. Potential Impacts. Leachate is liquid waste which results when water percolates through buried materials in sanitary landfills waste impoundments, and other disposal sites. Depending on the characteristics of the buried materials, leachate can contain inorganic and organic contaminants, as well as dissolved solids which can degrade groundwater supplies.

b. Land Use Associations. Land uses which may be associated with leachate generation are classified as waste industrial and commercial. Waste uses include sanitary landfills and other official dump sites.

c. Existing Conditions. Norwell has one closed landfill which is located outside the aquifer area.

5. Hazardous Wastes

a. Potential Impacts. Hazardous wastes are wastes which are toxic, reactive, corrosive or ignitable. Improper handling of hazardous wastes is an obvious threat to drinking waters; however, federal and state regulations have been enacted to reduce the threat of contamination, including water supply contamination. A less obvious source of hazardous wastes is what is commonly referred to as "household hazardous wastes." These include materials such as bleach, mothballs, paint remover, oven cleaner, wood preservative and used motor oil. Improperly disposed of, they also can reach groundwater or surface water and result in contamination of supplies. This is especially true in an unsewered area, such as in the water supply watershed. All materials disposed of "down the drain" will reach the groundwater through on-lot septic systems, which are not designed to treat many chemical wastes.

b. Land-use Assocations. All developed land use types have the potential to be associated with hazardous wastes. Twenty-three percent of the town is developed with residential, industrial, and commercial land uses. In addition, transportation corridors are susceptible to accidental spills.

c. Existing Conditions. There are eleven hazardous waste handlers on DEQE's Inventory (Table 4-9). Ten of these are hazardous waste generators. The regulatory list may not be comprehensive and could overlook smaller businesses who could also be handling detrimental materials.

Another potential source of hazardous materials is improperly disposed of household wastes. About 22 percent of the town is residentially developed and all of the homes dispose of their wastes on site.

Table 4-9

NORWELL HAZARDOUS WASTE HANDLERS

Name	Address	Activity Type	Regulatory Status
Atlantic Towing	271 Washington St.	G	2
Boston Whaler Inc.	412 Washington St.	G	
Colonial Village Refinishing	335 Washington St.	G + T	2
Fabric Care House	62 Pond St.	G	2
Fabricare House	32 Pond St.	G	2
Hancock Paint & Varnish Co.	109 Accord Park Dr.	G	2
Norwell One Stop Cleaners	Rte. 53	G	2
Queen Anne Cleaners	10 Washington St.	G	2
Queen Anne Arco	10 Washington St.	G	
Rietzl Porche AudiInc.	59 Pond St.		
Smith Print Inc.	90 Longwater Dr.	G	2

[1] Activity Type: G = Generator
T = Treat, Store, and Dispose

[2] Regulatory Status: 2 Non-regulated (small quantity)

6. Pesticides.

a. Potential Impacts. The term pesticide includes insecticides, herbicides and rodenticides. These are all chemical compounds used to control unwanted organisms such as insects, weeds and rodents. Since the compounds vary depending upon their target organisms, their potential water resources effects also vary greatly. Pesticides may enter water supplies by direct infiltration through the ground or by way of runoff. Water supply impacts may be caused by improper use storage, or disposal of pesticide products. In some locations, even properly regulated application may have the potential to impact water supplies.

b. Land Use Associations. Land uses associated with use of pesticides are residential, institutional, transportation, utility (electrical), and agricultural and recreation. Homeowners use pesticides to control insects, weeds and rodents in gardens and homes. Municipal departments of public works often use herbicides for part or road maintenance. Golf courses often use herbicides and fungicides to maintain the turf.

Utility companies use selective pesticide applications to eliminate tall-growing trees which interfere with the function of the utility lines. The general amount herbicides used for this is less than one gallon per acre.

The intent of railroad herbicide applications is to control all vegetation along the track since it may cause instability or lead to fires. The area usually treated is about 12 feet to either side of the center of the track, known as the railroad layout or ballast area. A number of chemicals are used together which generally amount to 5 to 8 gallons of herbicide per acre.

Organic pesticides may be used directly in lakes and reservoirs for control of aquatic insects. Other methods of their reaching water bodies are accidental drift from agricultural applications, and discharge of rinse water from equipment cleanup after application.

c. Existing Conditions. There are 393 acres of Agriculture land uses or about 3 percent of the town. Consequently the pesticide contamination risk in Norwell is from agricultural uses, residences, and utility rights of way.

7. Mining

a. Characteristics and Water Supply Impacts. Mining poses a threat to groundwater if the excavation reaches too close to the water table, not leaving a sufficient buffer zone for contaminants to be filtered out. Future land uses on abandoned mines should also be carefully regulated, considering the potential groundwater impacts.

b. Land Use Associations. Mining; sand and gravel excavation.

c. Existing Conditions. There has been very little mining in Norwell in the recent years. However, with the new construction of Route 3 to take place there will be a need for local gravel sources, and nearby towns will be likely to supply those needs.

Chapter 5

ZONING AND REGULATION OF LAND USE

The preceding chapter focused on land uses which have potential impacts on water supplies. In this chapter existing local, state, and federal laws and regulations which control those land uses will be summarized. The town's zoning bylaw will also be examined in order to determine the potential impacts of future development, and its compatibility with water supply protection. This regulatory analysis will form the basis of the recommendations made in the next chapter to strengthen the town's water supply protection measures.

EXISTING REGULATIONS

A host of local, state, and federal laws and regulations currently exist which regulate the land uses identified above as having potential water quality impacts. These laws and regulations are summarized in Figure 5-1 and described below.

Underground Fuel Storage

- Federal. The Environmental Protection Agency is developing new requirements which will set minimum standards for state regulations.

- State. The Massachusetts Board of Fire Prevention Regulations has issued new regulations governing underground fuel storage (527 CMR 9.00 et seq.). The regulations are promulgated by the state Fire Marshall and enforced at the local level by the Fire Chief. The major features of the regulations are requirements for:

    - tank registration
    - periodic tank leak testing
    - inventory control
    - removal of abandoned tanks
    - non-corrosive tanks

  The state regulations greatly enhance protection against leaking of larger commercial underground fuel tanks. However, it should be noted that the regulations exempt residential and farm tanks for home heating oil less than 100 gallons.

- Local. The Board of Selectmen issues licenses for gasoline storage tanks over 165 gallons and fuel oil storage over 10,000 gallons. The Fire Chief issues permits for fuel oil storage less than 10,000 gallons.

Figure 5-1
Potential Impacts and Management Techniques

REGULATIONS	Underground Fuel	Waste Water	Road Salt	Leachate	Hazardous Waste	Pesticides	Mining	Run Off Erosion
FEDERAL								
Resource Conservation and Recovery Act (RCRA)					●			
Clean Water Act		●						
STATE								
Fire Prevention Regulations (527 CMR 9.0)	●							
DEQE Solid Waste Regulations (310 CMR 19)				●				
DEQE Hazardous Waste Regulations (310 CMR 30)					●			
Pesticide Bureau Interim Guidelines						●		
TOWN								
Zoning Bylaw	●				●			
Subdivision Regulations								●
Board of Health		●		●				
Conservation Commission			●					●
Fire Department	●							
Earth Removal							●	

Potential Sources of Contamination

In addition, Norwell has adopted a General Bylaw which regulates the storage of underground fuel and hazardous chemicals. The Bylaw includes provisions which require registration of all existing underground tanks, installation standards for new and replacement tanks, and equipment replacement when leakage is confirmed. Fuel oil tanks connected to burning equipment are exempted from the requirements for leak prevention and detection.

Wastewater

- Federal. Industrial wastewater discharges are regulated under the federal Clean Water Act, which sets standards for discharges through The National Pollution Discharge Elimination System (NPDES) permit program. The NPDES permit program is implemented jointly by the federal Environmental Protection Agency and the state Department of Environmental Quality Engineering. The state has applied to EPA for delegation authority to administer the program itself. There are currently no NPDES permitted discharges in the town of Norwell.

- State/Local. Disposal of sanitary wastewater is regulated by the Board of Health under Title 5 of the State Environmental Code. Title 5 empowers the local Board of Health to administer and enforce the provisions of the State Environmental Code. The regulations establish requirements for siting and construction of septic systems. The Title 5 regulations are considered minimum standards, and local Boards of Health may adopt more stringent measures to protect public health and the environment.

- The Norwell Board of Health has adopted local regulations which supplement the state Title 5 standards. These include leaching area requirements and setback requirements as follows:

Table 5-1
NORWELL HEALTH REGULATIONS

Leaching Area Requirements
(square feet/gallon)

Minutes-Title 5 drop/inch	Leaching pits, chambers, trenches	Leaching Fields	State
2.0 or less	.75	1.5	1.4
2.5	.84	1.62	--
3.0	.93	1.74	--
3.5	.99	1.82	--
4.0	1.05	1.90	1.7
5.0	1.12	2.00	--
6.0	1.21	2.12	--
7.0	1.29	2.22	--
8.0	1.36	2.32	2.2
9.0	1.44	2.42	--
10.0	1.50	3.00	2.8
15.0	2.25	3.50	--
20.0	2.62	4.00	3.8
Over 20	Unsuitable	Unsuitable	

NOTE: There is a minimum leaching area requirement of 1200 square feet which supercedes the requirements of this table.

- Minimum leaching area is 1200 square feet
- Minimum septic tank size is 1500 gallons, or 1 1/2 times design flow, whichever is greter
- Sewage flow is calculated at 200 gallons per bedroom (Title 5 requires 110 gallons)
- Within the aquifer area, five feet of permeable soil is required between the maximum groundwater table and the bottom of the leaching facility. (Title 5 requires four feet).

- For septic systems constructed in watershed areas, tributary or recharge area going to a public potable water source or to an active private well, the setback requirements is 150 feet. Any septic system with a percolation rate more than 8 minutes per inch also requires a 150 foot setback. In non-watershed or recharge areas, the setback requirement is 100 feet.

Equally important to protecting groundwater quality is the proper operation and maintenance of septic systems. Periodic inspection is necessary, and the septic tank must be pumped out when greases and solids accumulate. However, there are no state or local regulations which require proper operation and maintenance practices.

Another threat to water quality is the disposal of hazardous materials in septic systems. Many household products contain toxic chemicals which are not properly treated by conventional septic systems. Even some septic system cleaners contain toxic chemicals. These materials should not be disposed of in septic systems.

Road Salt

The town bylaws require that a maximum of 1200 tons of salt be used for road deicing per year. There are three low-salt application areas in the aquifer area.

Leachate

- Federal. There are no federal regulations concerning sanitary landfills.

- State. Landfills are operated under state regulations administered by the Department of Environmental Quality Engineering (310 CMR 19.00). These cover site selection, construction, cover material, litter and dust control, drainage of surface water, and closure and final cover of the landfill.

  New state regulations have been drafted which afford much greater protection to groundwater. The new regulations require an impervious liner under the landfill, groundwater monitoring, runoff control, and landfill capping. Although not formally adopted as state regulations yet, DEQE is applying the new standards to new or expanded landfills.

- Local. The Board of Health has responsibility for assigning sites for sanitary landfills and transfer stations. The Board also has general powers under Chapter 111 to issue orders or regulations to protect the public health. There are currently no operating landfills in Norwell. There is one close landfill, which is capped, located outside the aquifer area.

Hazardous Wastes.

- Federal. Hazardous waste generation, treatment, storage, transportation, and disposal is regulated under the federal Resource Conservation and Recovery Act (RCRA). The Environmental Protection agency has delegated authority to the state of Massachusetts to administer and enforce the Act.

- State. The Massachusetts Hazardous Waste Management Act (Chapter 21 C) and the DEQE hazardous waste regulations (310 CMR 30) establish a system of control over hazardous wastes. All waste generators are registered, and all wastes produced (over a minimum quantity) are accounted for in a "cradle to grave" manifest system. All manifested wastes must be ultimately treated and/or disposed of by a licensed facility. There are standards for facilities which treat, store, and dispose of hazardous wastes. However, there are currently no licensed disposal facilities in Massachusetts; thus, all hazardous wastes must be transported to licensed facilities out of the state. Waste generators are classified as large quantity generators if they generate over 1000 kilograms per month o non-acutely hazardous wstes or more than 1 kilogram per month of acutely hazardous wastes. Quantities of waste above the large quantity threshold must be removed from the site within 90 days.

- Local. The town has an underground storage bylaw which regulates petroleum, hazardous or chemical storage containment systems (see section on underground fuel). Above-ground storage is not regulated.

Pesticides

- Federal. The Environmental Protection Agency tests pesticide products and approves their use, with label instructions for proper application procedures and safeguards.

- State. Guidelines for use of herbicides in utility and railroad right-of-way maintenance are being developed by the Pesticide Bureau of the Department of Food and Agriculture. Two sets of interim guidelines have been issued governing herbicide application. One regulates herbicide use on ballast areas of railroad layouts, and the other addresses herbicide use on both railroad and utility rights-of-way. Both sets of guidelines restrict application of pesticides within 400 feet of wells or surface water supplies, including tributary streams. Krenite is to be used between 50 and 400 feet of a water supply source. A 100 foot buffer is to be left on either side of a railroad ballast where it crosses a stream tributary to a surface water supply.

- Local. There are no town regulations concerning use of pesticides. The Conservation Commission can regulate pesticides through notice of intent, hearings, and orders of Condition (310 CMR 12).

Mining (Earth Removal)

- Federal. There are no federal regulations regarding earth removal.

- State. There are no state regulations regarding earth removal.

- Local. For Earth Removal a written application for a permit must be submitted to the board of Selectmen containing the following:
    - plot plan with original boundaries
    - topographical contours at 5-foot intervals
    - contours of all unrestored areas at time of application
    - contour of removal under last permit
    - contour of removal application area in 1 foot intervals
    - water table in application removal area

  Application is approved provided:
    - removal will not adversely affect thewater table or drainge in the Town
    - the removal will not create dust, noise, or fumes
    - the removal will not create a waste area within the Town
    - the removal will not create an area with different topography

  The Board of Selectmen shall require a suitable restoration and performance bond from the applicant before any permit is issued.

ZONING

The preceding chapter focused on existing land uses and their potential impact on water supplies. In this chapter, the town's zoning bylaw will be examined in order to determine the potential impacts of future development in the aquifer area and its compatibility with water supply protection.

Zoning determines the type and intensity of development which may occur within defined districts of the town. As such, it is one of the most important tools at the town's disposal to insure the long term protection of its water supplies. By defining critical water resource areas and restricting future land uses within those areas, the town can insure that incompatible or hazardous land uses do not threaten groundwater quality in the future. Sound management of the land use in the aquifer area will not only protect the public health, it will also help prevent a contamination incident which could cost the town millions of dollars in treatment and clean-up costs.

ZONING DISTRICTS

In Norwell, the 2087 acre aquifer area falls within portions of five zoning districts (see Map 4 and Table 5-2). Two of these districts are residential, and they cover about 1800 acres or 88 percent of the aquifer. About 251 acres, or 12 percent of the aquifer, is zoned for business. Each of the zoning districts is described below.

Table 5-2

ZONING OF THE AQUIFER AREA

District	Minimum Lot Size	Area in Aquifer (Acres)	Percent of Aquifer Area
Residence A	1 acre	1293	62
Residence B	1 acre	543	26
Business A	1 acre	21	1
Business B	1 acre	63	3
Business C	1 acre	167	8
Total		2087	100

Residential Districts

The residential districts in the aquifer area include two categories, Residence A and B. Both districts have a minumum lot size of one acre. Both districts allow one-family residences and municipal, utility, and institutional uses by right. The only difference between the two districts is the frontage requirements, which is not significant for groundwater protection. Agriculture, service business, and home occupations are also allowed, some of which may involve the use of chemicals which may affect water quality. Uses allowed by special permit include accessory service businesses (two yers limit) and accessory scientific uses. Permitted uses are summarized in Table 5-3.

Business Districts

There are portions of three business districts in the aquifer area: Business A, B, and C. Business A and B also allow residential uses (one-family in Business and one to three family in Business B). Business A allows businesses, shops, and services, excluding gasoline stations and auto repair. Business B allows light manufacturing, but prohibits gasoline stations and auto repair. Business C allows light manufacturing and also allows gasoline stations and automobile sales and repair. About 167 acres or 8 percent of the aquifer area, falls into this category (see Map 4). Table 5-3 summarized use regulations for all districts.

Table 5-3

ZONING ANALYSIS - WATER SUPPLY IMPACTS

District	Permitted Uses	Permitted Uses	Potential Impacts
Residence A&B	Residence (one-family) Municipal Buildings Public Utility Church, School Professional Office (3) Agriculture Home Occupation	Scientific Research and Development Accessory Service Business (2 years)	Septic Systems Underground fuel Pesticides, Fertilizers Household hazards Urban runoff
Business A	Residence (one-family) Municipal Buildings Public Utility Cemetery Church, School Professional (3) Agriculture Home occupations	Business and Services except auto repair, Sales and gasoline service. Accessory service business.	Septic Systems Underground fuel Pesticides, Fertilizers Household hazards Urban runoff Hazardous materials
Business B	Residence (1 to 3) Church, School Agriculture Retail Stores Professional Office Banks Restaurants	Light manufacturing Research Laboratories Wholesale Sales	Septic Systems Hazardous Materials Underground Fuel Urban runoff
Business C	Church, School Agriculture	Research Labs Light Manufacturing Wholesale Sales Professional Offices Banks, Restaurants Motels, Theaters Salesrooms Retail Stores Gasoline Stations Service Establishments	Septic Systems Underground Fuel Hazardous Materials Urban Runoff

Chapter 6

FINDINGS AND RECOMMENDATIONS

The previous chapters have examined the potential water quality impacts of existing land uses and of potential future land uses permitted under the current zoning bylaw. Existing laws, bylaws and regulations to control potential sources of contamination were reviewed, and their adequacy for groundwater protection was evaluated. As a result of these analyses, in this chapter new or amended bylaws and regulations will be recommended to strengthen the town's protection of its groundwater resources. These recommendations can be drawn together into a comprehensive groundwater protection programs as outlined below.

GROUNDWATER PROTECTION PROGRAM

AQUIFER MAPPING

Findings. In previous studies, the U.S. Geological Survey has prepared generalized maps of aquifers based upon surficial geology. However, these maps do not delineate the areas of contribution to the town's wells. Such mapping is needed to form the basis of a legally defensible groundwater protection district.

Recommendations. The town should conduct hydrogeologic studies to determine the areas of contribution to the wells. The data from the studies should be combined on a single map in order to delineate a groundwater protection district for the town.

ZONING

Findings. Norwell is fortunate that the vast majority of the aquifer area is zoned for residential uses. However, about 251 acres, or 12 percent of the aquifer, are zoned for business uses. Further, the zoning analysis has shown that a host of non-residential uses are permitted in districts which are nominally residential.

Recommendations. The zoning bylaw should be amended by adding an Aquifer Protection Overlay District. The boundaries of the district would be defined by the hydrogeologic studies described above.

The Aquifer Protection District would overlay existing zoning districts, adding additional requirements, much as the existing Floodplain, Watershed, Wetlands District does. The requirements include a prohibition of uses such as disposal of solid waste or liquid or leachable wastes, discharge of industrial wastewater on-site, storage of petroleum products underground, storage of road salt, animal feedlots, storage or disposal of hazardous wastes, automobile service and repair shops, and junk and salvage yards. A model Aquifer Protection District bylaw is in Appendix A.

EARTH REMOVAL REGULATIONS

Findings. Excavation to a depth of less than ten feet above the water table has potential impacts on groundwater quantity and quality. Excavation too close tot he water table can also place constraints on developing the site for other uses after mining activities have ended. In effect, high water table conditions can be created artificially under these circumstances, making site reclamation difficult. The Norwell bylaw includes Earth Removal Regulations which state that the depth of excavation may be specified as a permit condition, but no standards for excavation depth are included.

Recommendations. The Earth Removal bylaw should be amended to require that the maximum depth of excavation be at least ten (10) feet above the seasonal high water table. The water table elevation should be determined on site by soil borings and test wells which are monitored through at least one high water season, from December to April. An amendment is included in Appendix A.

HAZARDOUS MATERIALS

Findings. Improper storage, use or disposal of hazardous materials, even in relatively small quantities, may pose a threat of groundwater contamination. Numerous businesses and industries, small and large, handle materials which may be hazardous. Within the aquifer study area, 247 acres are zoned for business and industry, and 63 acres are already developed with such uses. Even if the zoning bylaw is amended as recommended, all existing uses would be grandfathered.

Recommendations. The town already has a bylaw which regulates underground storage of petroleum and hazardous chemicals. That bylaw could be amended to require registration and regulation of above ground storage of hazardous chemicals.

SUBDIVISON REGULATIONS

Findings. The town's subdivision regulations contain provisions for the regulation of surface drainage and runoff, but there are no provisions which directly take groundwater into consideration.

Recommendations. The Planning Board should amend the subdivision regulations by adding a provision which allows the Board to require information on groundwater resources, impacts, and mitigation measures. This provision would be optional and applied in appropriate cases at the discretion of the Planning Board. It should allow the Board to require such information as water table elevations, direction of groundwater flow, nutrient loading, and impacts on aquifers or recharge areas for public water supplies. Mitigation measures to be analyzed may include open and closed drainage systems, oil and grease separators, and detention basins for contaminant removal.

The amendment should allow the Board to require appropriate mitigation measures to protect groundwater quality and quantity.

A subdivision regulation amendment is included in Appendix A.

HOUSEHOLD HAZARDOUS WASTES

Findings. Although the aquifer area is primarily residential in character, there are many household products which pose a potential threat to water quantity if improperly disposed of. These include cleaners, solvents, polishes, paints, lubricants, antifreeze, and motor oil.

Recommendations. The town should conduct household hazardous waste collections on an annual basis, taking advantage of state financial assistance when available. Publicity for the collections should especially focus on the Aquifer Protection District. As part of this effort, there should be a public education campaign to discourage the improper disposal of household hazardous wastes. The town could also investigate the feasibility of operating a waste oil recycling project.

APPENDIX A

BYLAWS AND REGULATIONS

1 Aquifer Protection District

2 Earth Removal Bylaw amendment

3 Subdivision Regulation amendment

AQUIFER PROTECTION DISTRICT

SECTION I

Definitions

Animal Feedlot: A plot of land on which 25 livestock or more per acre are kept for the purposes of feeding.

Aquifer: Geologic formation composed of rock or sand and gravel that contains significant amounts of potentially recoverable potable water.

Groundwater: All the water found beneath the surface of the ground. In this bylaw the term refers to the slowly moving subsurface water present in aquifers and recharge areas.

Impervious Surface: Material on the ground that does not allow surface water to penetrate into the soil.

Leachable Wastes: Waste materials including solid wastes, sewage, sludge, and agricultural wastes that are capable of releasing water-borne contaminants to the surrounding environment.

Mining of Land: The removal or relocation of geologic materials such as topsoil, sand and gravel, metallic ores, or bedrock.

Recharge Areas: Areas composed of permeable stratified sand and gravel and certain wetlands that collect precipitation or surface water and carry it to aquifers.

Solid Wastes: Useless, unwanted, or discarded solid material with insufficient liquid content to be free flowing. This includes but is not limited to rubbish, garbage, scrap materials, junk, refuse, inert fill material and landscape refuse.

SECTION II

Purpose of District

The purpose of this Aquifer Protection District is:

(A) to promote the health, safety, and general welfare of the community;

(B) to protect, preserve and maintain the existing and potential groundwater supply and groundwater recharge areas within the town;

(C) to preserve and protect present and potential sources of water supply for the public health and safety;

(D) to conserve the natural resources of the town;

(E) to prevent blight and the pollution of the environment.

SECTION III

Scope of Authority

The Aquifer Protection District shall be considered as overlying other zoning districts. No uses not permitted in the portions of the districts so overlaid shall be permitted in this district.

SECTION IV

Establishment and Delineation of Aquifer Protection District

For the purposes of this district, there are hereby established within the town certain aquifer protection areas, consisting of aquifers and/or aquifer recharge areas, which are delineated on a map at a scale of 1 inch to ____ feet entitled "Aquifer Protection Areas, Town of ________________." This map is hereby made a part of this district and of the town zoning bylaw and is on file in the Office of the Town Clerk. As delineated on the map, the Aquifer Protection District comprises the following elements:

A. Aquifers, together with:

   1. the surface of the land lying above them, and

   2. a surrounding protective strip, approximately 250 feet in width.

B. Recharge areas, defined by the extent of permeable stratified sand and gravel and recharging wetlands within them that drain into the aquifer, together with:

   1. a surrounding protective strip, approximately 100 feet in width, and

   2. the shoreline, to seasonal high water line, of any stream that flows into the recharge area.

Where the bounds are delineated are in doubt or in dispute, the burden of proof shall be upon the owner(s) of the land in question to show where they should properly be located. At the request of the owner(s) the town may engage a professional geologist or soil scientist to determine more accurately the location and extent of an aquifer or recharge area, and may charge the owner(s) for all or part of the cost of the investigation.

3. the disposal of liquid or leachable wastes, except one- or two-family residential subsurface waste disposal systems;

4. the rendering impervious of more than __% of any lot;

5. industrial uses which discharge process wastewater on-site;

6. [use or] storage of road salt or other deicing chemicals;

7. dumping of snow containing deicing chemicals which is brought in from outside the district;

8. animal feedlots;

9. the storage of uncovered manure;

10. mining of land except as incidental to a permitted use;

11. the storage or disposal of hazardous wastes, as defined by the Hazardous Waste Regulations promulgated by the Hazardous Waste Board, the Water Resources Commission, and the Division of Water Pollution Control under the provisions of Sections 27(8), 52, 57, and 58 of Chapter 21 of the General Laws.

12. Automotive service and repair shops, junk and salvage yards.

C. The following uses are permitted by Special Permit, subject to the approval of the [Special Permit Authority] under such conditions[4] as they may require and also subject to s. B:

1. the application of pesticides for non-domestic or non-agricultural uses provided that all necessary precautions shall be taken to prevent hazardous concentrations of pesticides in the water and on the land within the Aquifer Protection District as a result of such application. Such precautions include, but are not limited to, erosion control techniques, the control of runoff water (or the use of pesticides having low solubility in water), the prevention of volatilization and redeposition of pesticides and the lateral displacement (i.e. wind drift) of pesticides;[5]

2. the application of fertilizers for non-domestic or non-agricultural uses provided that such application shall be made in such a manner as to minimize adverse impacts on surface and groundwater due to nutrient transport and deposition and sedimentation;

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[4] The SPA should establish regulations under this section to insure against contamination and loss of recharge by such means as water-tight sewer pipes, ban on road salt, erosion control, preservation of ground cover, permeable paving, maintenance of catch basins.

[5] See note on pesticides in the Watershed Protection bylaw in ch. 2.

SECTION V

Use Regulations

Within the Aquifer Protection District, these regulations shall apply:

A. The following uses are permitted within the Aquifer Protection District, subject to s. B, provided that all necessary permits, orders, or approvals required by local, state, or federal law are also obtained:

1. conservation of soil, water, plants and wildlife;

2. outdoor recreation, nature study, boating, fishing, and hunting where otherwise legally permitted;

3. foot, bicycle and/or horse paths and bridges;

4. normal operation and maintenance of existing water bodies and dams, splash boards, and other water control, supply and conservation devices;

5. maintenance, repair [and enlargement] of any existing structure provided there is no increase in impermeable pavement;

6. residential development[1], if permitted in the underlying district, provided that no more than 10 percent of a building lot (including the portion of any new street abutting the lot) is rendered impervious.[2]

7. farming, gardening, nursery, conservation, forestry, harvesting and grazing provided that fertilizers, herbicides, pesticides, manure and other leachable materials are not stored outdoors.[3]

[8. Optional: creation of ponds up to one acre in size.]

B. The following uses are prohibited:

1. disposal of solid wastes, other than brush and stumps;

2. storage of petroleum or other refined petroleum product except within buildings which it will heat;

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[1] The use of pesticides and fertilizers in connection with these activities may be made subject to reasonable regulations (see Ch. 2).

[2] Larger parking areas, if required, must be constructed with permeable paving.

[3] The community may install test wells to monitor for contamination by herbicides, pesticides or fertilizers.

(b) is appropriate to the natural topography, soils, and other characteristics of the site to be developed;

(c) will not, during construction or thereafter, have an adverse environmental impact on the aquifer or recharge area; and

(d) will not adversely affect an existing or potential water supply.

EARTH REMOVAL BYLAW AMENDMENT

No permit shall be issued or renewed under this Bylaw until the applicant has submitted to the Board current and complete information on the actual and proposed depth of excavation and the maximum groundwater elevation throughout the entire area proposed to be excavated. Maximum groundwater elevation shall be determined by means of monitoring wells, test pits and soil borings during the months of March, April or May. Such tests shall be conducted by a Massachusetts Registered Professional Engineer at the expense of the applicant. Test results shall be submitted to the Board over the engineer's stamp.

The groundwater monitoring wells shall be left in place during the period that the applicant holds a permit hereunder, and readings therefrom shall be taken during March, April or May of each year. The results of such readings shall be submitted to the Board over the engineer's stamp.

Excavation shall be restricted to those areas which are at elevations ten feet or more above the maximum groundwater elevation as determined by the most recent testing conducted under the provisions of this subparagraph.

SUBDIVISION REGULATION AMENDMENTS

Procedure for the Submission and Approval of Plans

Grading Plan

The Board may require that the following be submitted where such information is necessary to evaluate the plan because of special circumstances of the proposal or its location including, but not limited to, proximity to aquifers, groundwater recharge areas, or public water supply wells:

a. location of aquifers or recharge areas for existing or potential drinking water supplies.

b. Analysis of open and closed drainage system alternatives, examining effects upon the recharge of aquifers and the quality of the groundwater.

c. Maximum groundwater table elevation and direction of groundwater flow.

Required Improvements

Improvement Specifications

Storm and Surface Drainage

The Board may require that the following measures be taken because of special circumstances of the proposal or its location including, but not limited to, proximity to aquifers, groundwater recharge areas, or public water supply wells:

(1) Design and construction shall reduce, to the extent possible, the following:

- dimensions of paved areas
- encroachment within any wetland or floodplain
- volume of cut and fill
- area over which vegetation will be distributed
- extent of waterways altered or relocated

(2) Pollution control devices, including provisions for contaminant removal employing detention basins with subsurface drains or perforated risers, oil and grit separator catch basins, and other appropriate devices.

APPENDIX B

MAPS

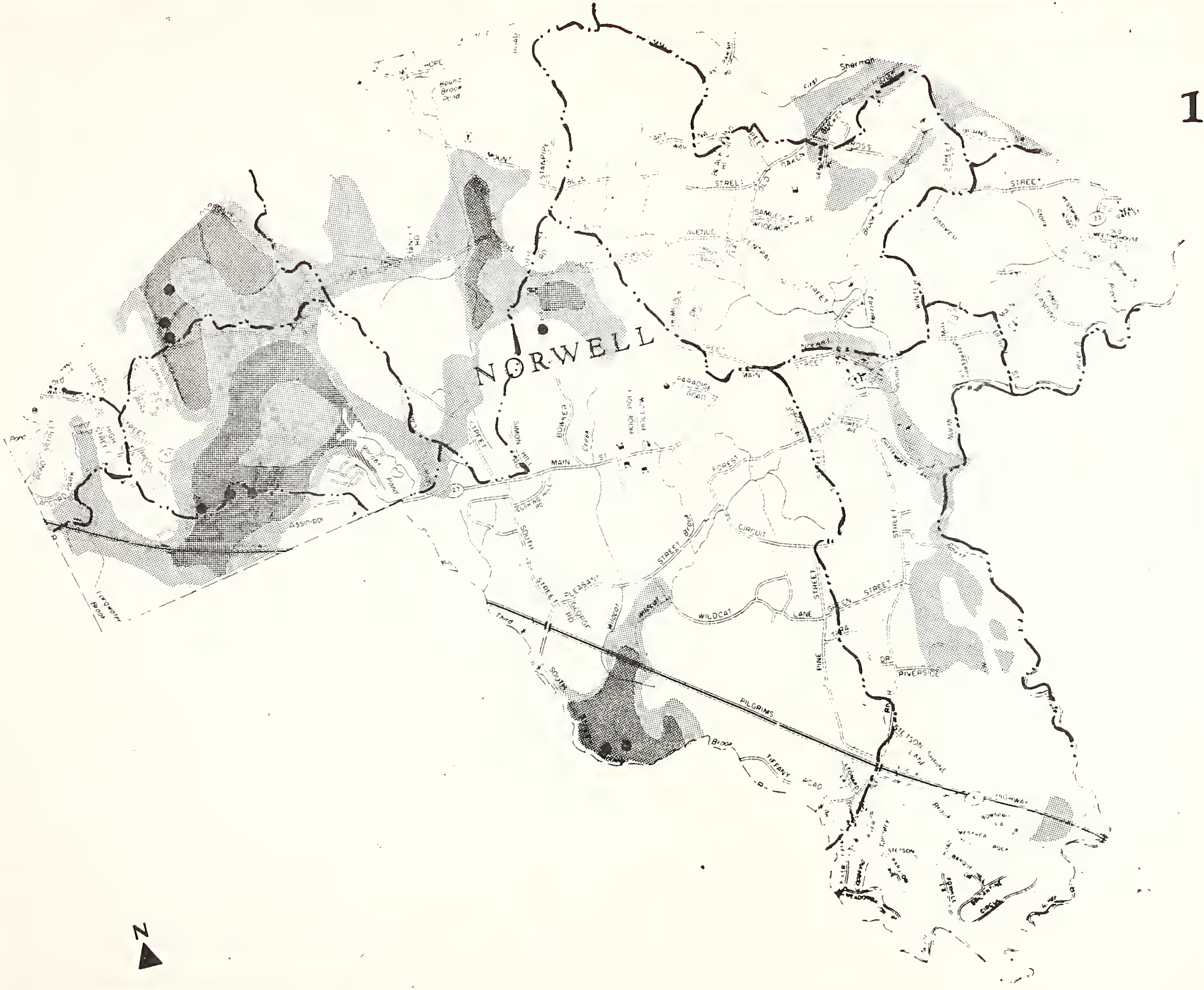
1 Water Resources and Environmentally Sensitive Areas

2 Land Use

3 Potential Sources of Contamination

4 Zoning

1. Environmentally Sensitive Areas



Groundwater Favorability

▨ high

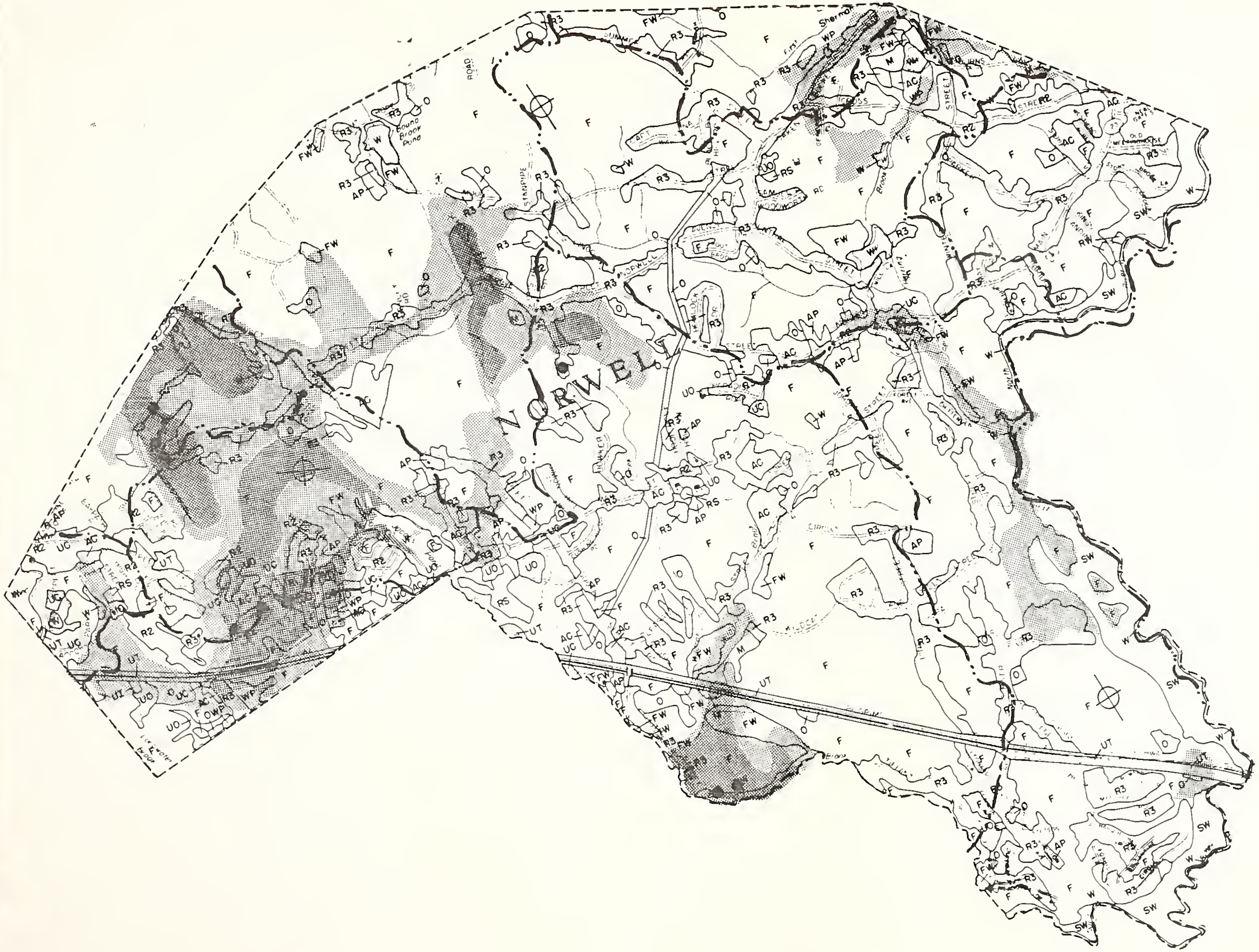
▨ moderate

● wells

-··- watersheds

NORWELL

2. Land Use



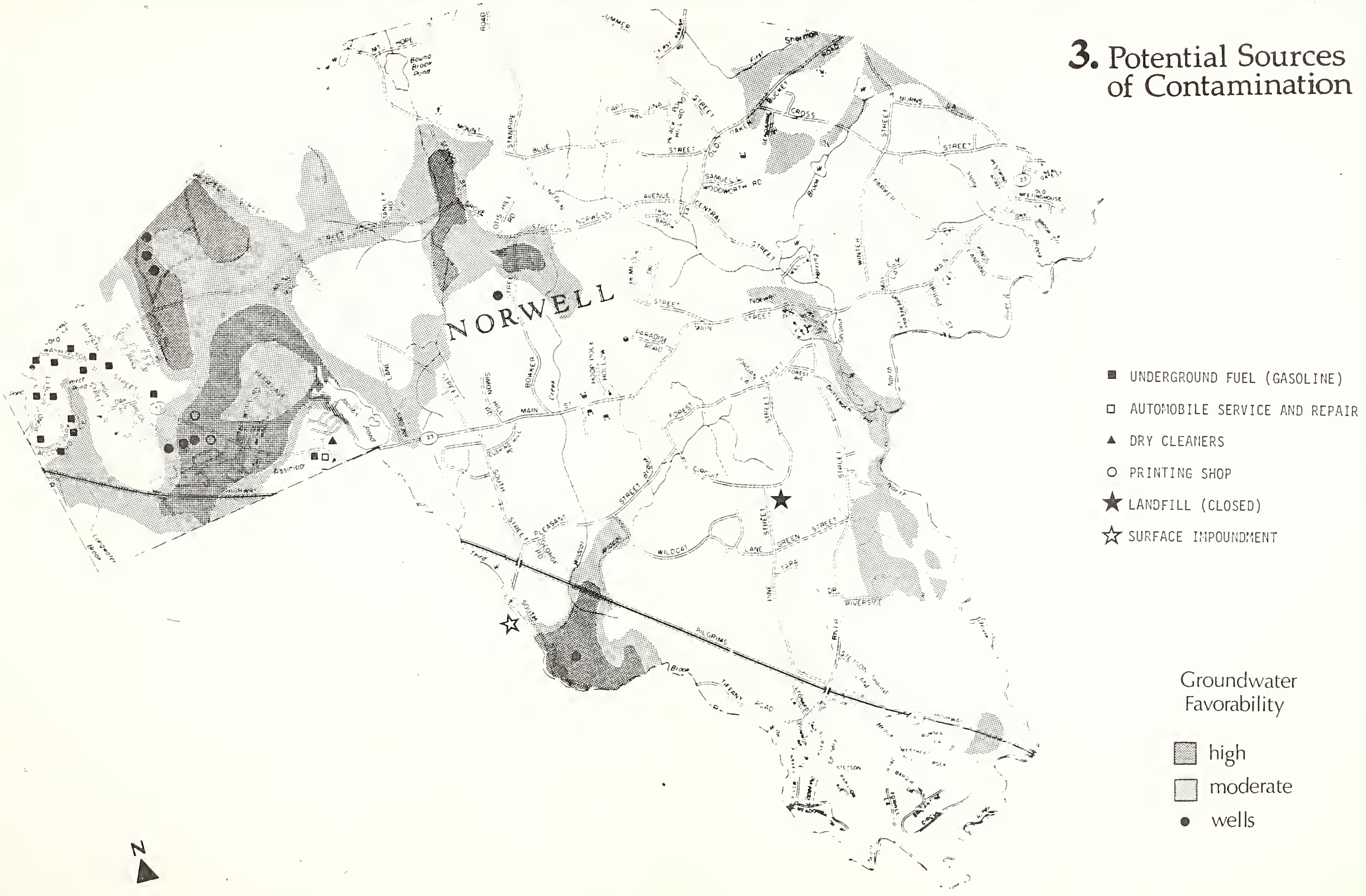
LEGEND - 1980 LAND USE CATEGORIES

UI	Industrial	AC	Cropland
UC	Commercial	AP	Pasture
R1	Dense Residential	WP	Woody Perennial
R2	Medium Residential	O	Open
R3	Sparse Residential	W	Water
UT	Transportation	FW	Fresh Wetland
UO	Open and Public	SW	Salt Wetland
UW	Waste Disposal	RW	Water Recreation
M	Mining	RP	Participation Recreation
F	Forest	RS	Spectator Recreation

Groundwater Favorability

- ▩ high
- ▨ moderate
- ● wells
- –··– watersheds

3. Potential Sources of Contamination



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NORWELL

4. Zoning